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ABSTRACT

The development procedures, test administration, data analysis, and future implications of a statewide needs assessment effort in the state of Ohio are described. A 114-item test) administered to 152 schools in Ohio in April 1979, was used to determine the statewide needs in science at the grade 8 level. Four content domains were included: (1) physical science; (2) life science; (3) earth science; and (4) integrated topics. Areas of strength and weakness were determined based upon detailed analyses and comparisons of the actual scores to predetermined minimal and optimal expectancy levels. Results pointed out that students' performance was best in the domain of integrated topics, which included items on science processes. Earth science concepts were best understood. The remaining two areas, physical science and life science, were definitely weaker areas in terms of student achievement. Only five out of fourteen objectives in these two areas met or exceeded the minimal expectancy levels. (Authors/JN)

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SCIENCE NEEDS ASSESSMENT: A STATEWIDE APPROACH

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In June, 1976, the Ohio State Legislature mandated that the Ohio Department of Education conduct an annual assessment in selected subjects at the fourth, eighth, and twelfth grades. The results of the assessment were to be used to identify needs and to provide baseline data for making recommendations regarding the implementation of the minimum competency examinations at selected grade levels. The first statewide test in science was administered to twelfth-grade students in 1978. Subsequently, a second test was developed for eighth-grade students and administered in 1979. This paper describes the procedures and results of the latter program.

CONSTRUCTION OF THE TEST

a. Formulation of Objectives:

With the aid of local professional organizations and the state science supervisor, the position held at the time by the senior author of this paper, a panel of educators was formed to advise and assist the staff from the Evaluation Center of Western Michigan University which had entered into a contract with the Ohio Department of Education to carry on this project. The panel members represented school teachers, curriculum coordinators, and university faculty. The first task of the science panel was to establish a list of objectives that represented science programs taught in Ohio schools up to the end of eighth grade. Specific criteria were developed to determine if an objective was to be considered suitable for the test. From a large pool of objectives, collected from previous assessments in other locations, the panel members chose an initial list of 50 objectives. This list of objectives was circulated for review to 100 educators and non-educators in 13 school districts representing different parts of the state and schools of different sizes. The field review data were closely examined and a final list of 25 objectives was selected, requiring some rewriting to reflect the precise intent of the objectives (see attachment A).

b. Preparation of Items:

The panel felt that at least 8-10 items per objective were needed to ensure a thorough field testing. After a close examination of the items available from other sources, the panel selected approximately 130 items for field review. Another 100 new items were generated,

thereby making a total of 233 items for the field test. The format of the Ohio test (multiple-choice items with four options) was different from many available tests.

c. Field Test:

The items were arranged in eight separate test forms, each containing all items available for from 2 to 4 objectives. Thus each test form had approximately 30 items. Eighteen schools from nine shool districts representing urban, suburban, and rural areas were sent specific test forms. In all, the test was administered to 433 students. Each test form was administered in at least three school districts. A questionnaire was also completed by individuals (science teachers) who administered the tests with a request for their comments regarding the vocabulary, item format, and directions given for the test.

Item analysis for each test form was completed based on the field test data. The information on item difficulty and discrimination index along with other data was closely examined by the content panel and technical experts. As a result, a final form of the test was developed. This form contained 114 items based on 25 objectives. The items were arranged under four specific domains, namely, Integrated Science Topics, Physical Science, Earth Science, and Life Science.

d. Setting Minimum and Optimum Expectations:

In order to use the test for the purpose of needs assessment, an elaborate procedure was employed to set expectancy levels. The test was sent to 26 randomly selected schools. Each building administrator was asked to identify four science and four non-science teachers to review the test for their perceptions about the level of difficulty of each test item, and the percentage of students correctly answering each item that would represent minimally acceptable and optimally acceptable performance. The teachers rated each question as either easy, moderate, or difficult.

Similarly, the content panel set expectancy levels for test items and each objective. The procedure established to accomplish this task included the setting of individual expectancy levels by each member, the comparison with the levels established by other members, a chance to advocate the inclusion of individual choices, and the seeking of a consensus. Data from the field were examined to compare against the perceptions of individual panel members and to arrive at the choice of expectancy levels for each test item.

ADMINISTRATION OF THE TEST

A stratified random sample of 152 schools was drawn from a list of all the public and non-public schools in Ohio. The strata used to classify schools included four size-of-community categories, percent of non-minority students in the schools, and percent of low-income families within the school's attendance area.

The actual selection of students was made at each school by the local administrators following detailed instructions sent with the materials to schools. According to these instructions, each school arranged the names of all eligible students in alphabetical order and assigned each student a sequence number. Using a table of random numbers (supplied with the test materials), 20 to 24 students were selected to participate in the test. A total of 3,109 students from 146 schools were entered in the statistical analysis.

ANALYSIS OF THE DATA

The data analysis was carried out by arranging information according to socio-economic status, sex, race, and race by socio-economic status. Statistical programs were run to determine student performance on each of the four domains, i.e., Integrated Science, Physical Science, Earth Science, and Life Science.

Tables 1-4 indicate the mean scores for each domain arranged by sex, race, and community size where schools were located. The data indicated that there were significant differences (0.05 level) for male and female students in the Earth Science and Physical Science domains. Scores for white and non-white students were significantly different (0.05 level) in all four domains. Similarly, the students in large city schools consistently scored significantly lower (0.05 level) than the other three types of schools in all four domains.

Table 5 shows student performance by objectives relative to the expectancy levels set earlier. The students generally met or exceeded the minimum expectancy levels on six out of the eight objectives in the area of Integrated Science (this domain consisted of items that represent science processes), on only three out of the eight objectives in Physical Science, on two out of the three objectives in the area of Earth Science, and on two out of the six objectives in the Life Science domain.

CONCLUSIONS

The eighth-grade science test used in Ohio may prove to be a useful instrument for replication studies in the future. Individual school districts have an opportunity to compare their scores against the statewide sample. A small number of schools have, indeed, used the test for that purpose. The instrument has certain limitations such as its size and the fatigue factor that might be involved in taking the test.

The data from the Ohio sample corroborates the conclusions of the National Assessment of Educational Progress (NAEP). The students do no have a basic understanding of the major concepts in Physical Science and Life Science. Despite an increase in the type of textbooks and other instructional materials in the past 10-15 years for elementary and middle/junior high school science programs, student performance still falls far short of the expected level necessary in the basic areas of science.

Further investigations of the causes of and the strategies to remedy the weaknesses in science instruction cannot be delayed. In an era of budget cuts and alarming criticism of schools for lack of accountability, it is imperative that science educators look beyond the surface for improving science instruction in schools.

TABLE 1

MEAN SCORES FOR INTEGRATED SCIENCE TOPICS

Objectives 1-8

Questions 1-38

Reporting Group		Sample size	Mean Scores	Standard Error
	All	3109	27.79	0.151
SEX				
	Male	1532	27.82	0.181
	Female	1573	27.77	0.180
RACE				
	White	2622	38.58**	0.146
	Non-white	478	23.07**	0.443
COMMUNITY SIZE				
	Large city	676	24.78**	0.383
	Suburban	954	29.14**	0.281
	Other city	743	28.24	0.263
	Rural	736	28.23**	0.207

TABLE 2

MEAN SCORES FOR PHYSICAL SCIENCE DOMAIN

Objectives 9-16
Questions 39-69

Reporting Group	Sample Size	Mean Scores	Standard Error
ALL	3109	17.22	0.151
SEX			
Male	1532	17.68**	0.158
Female	1573	16.78**	0.191
RACE			
White	2622	17.72**	0.169
Non-white	478	14.18**	0.280
COMMUNITY SIZE			
Large city	676	14.90**	0.336
Suburban	954	18.41**	0.259
Other city	743	17.57	0.231
Rural	736	17.37	0.271

TABLE 3

MEAN SCORES FOR EARTH SCIENCE DOMAIN

Reporting Group	Sample Size	Mean Scores (Objectives 17-19, Questions 70-84)	Standard Error
ALL	3109	8.13	0.091
SEX			
Male	1532	8.33**	0.110
Female	1573	7.93**	0.157
RACE			
White	2622	8.48**	0.097
Non-white	478	6.00**	0.157
COMMUNITY SIZE			
Large city	676	6.70**	0.181
Suburban	954	8.40*	0.126
Other city	743	8.53**	0.171
Rural	736	8.57**	0.188

TABLE 4

MEAN SCORES FOR LIFE SCIENCE DOMAIN

Objectives 20-25
Questions 85-114

Reporting Group	Sample Size	Mean Scores	Standard Error
ALL	3109	18.00	0.158
SEX			
Male	1532	17.83	0.186
Female	1573	18.17	0.196
RACE			
White	2622	18.58**	0.171
Non-white	478	14.52**	0.329
COMMUNITY SIZE			
Large city	676	15.26**	0.399
Suburban	954	19.28**	0.298
Other city	743	18.51*	0.238
Rural	736	18.22	0.240

TABLE 5

STUDENT PERFORMANCE BY OBJECTIVE

SCIENCE - EIGHTH GRADE

Objective	Number of Items Per Objective	Average Percent Correct	Number of Items on Which Minimum Performance Would Indicate an Acceptable Level of Achievement For The Objective	Number of Items on Which The Minimum Level of Performance Was Achieved For The Objective
1	5	71	4	3
2	5	70	3	4
3	5	83	3	4
4	5	86	4	5
5	5	54	3	3
6	3	78	2	3
7	5	85	3	5
8	5	60	4	3
9	5	59	4	2
10	5	59	4	2
11	3	29	2	0
12	3	66	2	3
13	5	40	3	0
14	2	80	2	2
15	3	68	2	2
16	5	56	4	2
17	5	45	3	2
18	5	67	4	4
19	5	51	2	3
20	5	83	4	5
21	5	46	3	1
22	5	61	4	3
23	5	48	3	3
24	5	50	3	1
25	5	71	4	3

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